



Standard Specification for Abrasion-Resistant Cast Irons¹

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1. Scope

1.1 This specification covers a group of white cast irons that have been alloyed to secure high resistance to abrasive wear in the applications of the mining, milling, earth-handling, and manufacturing industries.

1.2 Simple and low-alloy white cast irons that consist essentially of iron carbides and pearlite are specifically excluded from this specification.

1.3 The values stated in inch-pound units or SI units are to be regarded separately as the standard. Within the text, SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 ASTM Standards:

E 10 Test Method for Brinell Hardness of Metallic Materials²

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials²

E 92 Test Method for Vickers Hardness of Metallic Materials²

E 350 Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron³

E 351 Test Methods for Chemical Analysis of Cast Iron—All Types³

3. Ordering Information

3.1 Orders for material in this specification should include the following information:

- 3.1.1 Quantity,
- 3.1.2 Specification number, class, and type,
- 3.1.3 Description of the casting, pattern number, or drawing,
- 3.1.4 Chilling of the casting, if required (see 4.2),

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² Annual Book of ASTM Standards, Vol 03.01.

³ Annual Book of ASTM Standards, Vol 03.05.

3.1.5 Heat treat condition (see 5.1),

3.1.6 Hardness level, if supplied hardened or hardened and stress relieved, and

3.1.7 Hardness method, Brinell, Rockwell, Vickers (see Section 9). If the hardness method is not specified, it shall be at the manufacturer's option.

4. Method of Manufacture

4.1 These alloys may be made by any suitable melting process.

4.2 If the casting is to be chilled or otherwise specially treated on any portion, the inquiries and the purchase order shall so state and a properly marked drawing of the casting will accompany both the inquiry and the purchase order.

5. Heat Treatment

5.1 The casting will be supplied in one of the following conditions:

- 5.1.1 As-cast,
- 5.1.2 As-cast and stress relieved,
- 5.1.3 Hardened,
- 5.1.4 Hardened and stress relieved, or
- 5.1.5 Softened for machining.

5.2 Unless otherwise specified by the purchaser, the manufacturer shall supply the castings in the heat treatment he deems best for the application.

5.3 If the heat treatment specified for delivered condition is not that of final use, it shall be the responsibility of the purchaser to provide the additional heat treatment.

5.4 Class II and Class III alloys are frequently ordered in the annealed condition with a maximum hardness of 400 HB. After machining operations are performed the castings may then be hardened. If both annealing and machining are to be performed by the manufacturer, as specified in the inquiry, contract, or order, the purchaser may then specify delivery in the hardened condition. If the purchaser specifies delivery in the annealed condition, subsequent hardening (and stress-relief, if it is desired) is the responsibility of the purchaser.

6. Chemical Composition

6.1 The composition of the metal of a class and type produced under this specification shall fall within the ranges

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prescribed in Table 1 for that class and type.

6.2 Spectrographic, X-ray, or wet chemical laboratory techniques are acceptable for routine and control determinations, but shall be standardized against, and give essentially the same results as, the umpire methods specified in 6.3 of this specification.

6.3 In case of dispute, umpire determinations of the chemical analysis of the metal shall be made using ASTM standard methods detailed as follows:

6.3.1 The following is in accordance with Test Methods E 351:

6.3.1.1 Carbon, Total by the Combustion Gravimetric Method.

6.3.1.2 Chromium by the Peroxydisulfate-Oxidation Titrimetric Method.

6.3.1.3 Copper by the Sulfide Precipitation-Electrodeposition Gravimetric Method.

6.3.1.4 Manganese by the Peroxydisulfate-Arsenite Titrimetric Method.

6.3.1.5 Nickel by the Dimethylglyoxime Gravimetric Method.

6.3.1.6 Phosphorus by the Molybdenum Blue Photometric Method.

6.3.1.7 Sulfur by the Combustion-Iodate Titration Method.

6.3.2 The following is in accordance with Test Methods E 350:

6.3.2.1 Molybdenum by the Photometric Method.

7. Microstructure

7.1 The alloys covered by this specification are expected to have microstructures that consist essentially of carbides, martensite, bainite, austenite; and in exceptional cases minor amounts of graphite or pearlite.

7.2 The microstructure will not be routinely determined nor reported except in accordance with special agreement between the manufacturer and the purchaser, or in cases of dispute.

8. Hardness Requirements

8.1 The castings shall conform to the hardness requirements specified in Table 2.

8.2 The hardness test shall be performed on the original surface of the casting or up to $\frac{1}{8}$ in. (3 mm) below that surface.

9. Hardness Method

9.1 Perform the hardness test in accordance with one of the following methods to be specified by the purchaser:

9.1.1 Test Method E 10 (Brinell) using a tungsten carbide ball and 3000 kgf load,

9.1.2 Test Method E 18 (Rockwell) using a diamond cone penetrator, 150 kgf load, and the Rockwell C Scale, or

9.1.3 Test Method E 92 (Vickers).

10. Keywords

10.1 abrasion resistant; alloyed cast iron; cast iron; white cast iron

TABLE 1 Chemical Requirements, Weight %

Class	Type	Designation	Carbon	Manganese	Silicon	Nickel	Chromium	Molybdenum	Copper	Phosphorus	Sulfur
I	A	Ni-Cr-Hc	2.8-3.6	2.0 max	0.8 max	3.3-5.0	1.4-4.0	1.0 max	...	0.3 max	0.15 max
I	B	Ni-Cr-Lc	2.4-3.0	2.0 max	0.8 max	3.3-5.0	1.4-4.0	1.0 max	...	0.3 max	0.15 max
I	C	Ni-Cr-GB	2.5-3.7	2.0 max	0.8 max	4.0 max	1.0-2.5	1.0 max	...	0.3 max	0.15 max
I	D	Ni-HiCr	2.5-3.6	2.0 max	2.0 max	4.5-7.0	7.0-11.0	1.5 max	...	0.10 max	0.15 max
II	A	12 % Cr	2.0-3.3	2.0 max	1.5 max	2.5 max	11.0-14.0	3.0 max	1.2 max	0.10 max	0.06 max
II	B	15 % Cr-Mo	2.0-3.3	2.0 max	1.5 max	2.5 max	14.0-18.0	3.0 max	1.2 max	0.10 max	0.06 max
II	D	20 % Cr-Mo	2.0-3.3	2.0 max	1.0-2.2	2.5 max	18.0-23.0	3.0 max	1.2 max	0.10 max	0.06 max
III	A	25 % Cr	2.0-3.3	2.0 max	1.5 max	2.5 max	23.0-30.0	3.0 max	1.2 max	0.10 max	0.06 max

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TABLE 2 Hardness Requirements

Class	Type	Designation	Hardness Value-HB											
			Sand Cast, min ^A						Chill Cast, min ^B					
			As Cast or As Cast and Stress Relieved			Hardened or Hardened and Stress Relieved			Level 1			Level 2		
			HB	HRC	HV	HB	HRC	HV	HB	HRC	HV	HB	HRC	HV
I	A	Ni-Cr-HiC	550	53	600	56	660	59	715	600	56	660	56	...
I	B	Ni-Cr-LoC	550	53	600	56	660	59	715	600	56	660	56	...
I	C	Ni-Cr-GB	550	53	600	56	660	59	715	600	56	660	400	41
I	D	Ni-HiCr	500	50	540	600	56	660	59	715	550	53	600	...
II	A	12 % Cr	550	53	600	56	660	59	715	550	53	600	400	41
II	B	15 % Cr-Mo	450	46	485	600	56	660	59	715	...	...	400	41
II	D	20 % Cr-Mo	450	46	485	600	56	660	59	715	...	...	400	41
III	A	25 % Cr	450	46	485	600	56	660	59	715	...	...	400	41

^A 90 % of the minimum surface hardness level shall be maintained to a depth of 40 % of the casting section, with any softer material being at the thermal center of the casting. A sampling procedure should be established by agreement between the supplier and the purchaser.

^B Non-chilled areas of casting shall meet minimum hardness or sand cast requirements.

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